A software package is proposed for determining cross sections of spallation, fission, or fragmentation by activation methods. Various additions have been made to the method, including correction for single and double escape peaks on the areas of the $\gamma$ lines for the residual nuclei, and for the dead time of the measurement system, with a proposal for the complete identification of all lines of each nuclide observed on the basis of the internal intensity ratios derived from a nuclear database.

Activation methods may be applied to the products from spallation, fission, and fragmentation if the difficulties can be overcome in processing the large amount of spectrometric data. When a target is bombarded by particles of intermediate or high energy, many reaction channels are active, and therefore many different radionuclides are formed. Determining the cross sections for the formation of these is laborious and requires special algorithms [1, 2]. In recent years, we have accumulated research data on reaction cross sections in spallation and fragmentation, during which we have used various data-processing techniques in precision nuclear spectroscopy. This has made it necessary to upgrade the techniques for processing the experimental data and to set up a computerized system, which should improve the accuracy and effectiveness in the processing and assist in obtaining a complete solution.

The $\gamma$ spectra were recorded in an experiment with the Lyap phasotron at the Joint Nuclear Research Institute on irradiating targets with protons of energy 660 MeV. These spectra were measured with two ultrapure Ge detectors. The first had an energy resolution of 1.8 keV (at $E_{\gamma} = 1332$ keV) and efficiency 19%, while the second had 1.9 keV and 28% respectively. The measurements were usually made in the range 50–3500 keV, but to suppress the strong x rays and low-energy $\gamma$ rays, we used filters of Cu (1 mm), Cd (1 mm), and Pb (1–10 mm). It was particularly important to use such filters with irradiated radioactive targets composed of $^{129}$I, $^{237}$Np, and $^{241}$Am. The $\gamma$ rays in that energy range were transformed into 8192-channel spectra by means of ORTEC analyzers: MASTER 919 or MASTER 921, with a fast ORTEC 973 amplifier. The spectra began to be measured a few minutes after the end of the irradiation and the measurements continued for several months with increasing measurement times in order to detect the long-lived residual nuclei. In order to collect the optimal statistics in the measurements, the distance $d$ between the radioactive source and the detector was varied over the range from 8 cm to 1.5 m. We chose the minimum value $d = 8$ cm in order to suppress cascade transition summation. The energies and peak areas of the $\gamma$ rays were determined by means of the DEIMOS program [3], which operates automatically or interac-
(the operator sets approximate values for the positions of the line peaks and the background boundaries). The background was calculated as the sum of a linear or parabolic function and a power law. We determined not only the line areas but also the maximum possible area of a line that is not observed with the given background:

\[ \hat{S}_\gamma(K_i) = \frac{3}{2} \sqrt{N(K_i)} \text{FWHM}, \]

in which \(N(K_i)\) is the number of counts in channel \(K_i\), and FWHM is the full width at half maximum. We also performed energy calibrations on two or more \(\gamma\) lines and calculated the energies and the errors in them for all the observed \(\gamma\) rays. To obtain